

1. **Applicant's election** with traverse of species A(i) thermal heat treatment for drop formation or fragmentation of the thin film & **species B(i) carbon nanotube or nanofiber formation** using the drops or fragments in the reply filed on 8/3/2009 is acknowledged. The traversal is on the ground(s) that the "office has not provided adequate reasons or examples to support a conclusion that species, as claimed, are indeed patently distinct". This is not found persuasive because it is unclear to the examiner exactly what about the species applicants consider to be inadequately differentiated.

With respect to **species B**, is unclear to the examiner why applicants consider carbon nanotube formation & oxide layer formation to be equivalent species, since any person having taken high school chemistry would consider these to be significantly different materials, as carbon & oxide is significantly different chemistries (see any periodic table), hence not be expected to be catalyzed or formed in the by the same means (chemistry) on the same surface. While applicant's argument implies that they consider these species equivalent, they have not explicitly said so on the record, nor have they provided any evidence on why deposition of carbon nanotubes or deposition of an oxide layer should be considered equivalent uses of the fragmented layer or of the formed drops (which ever applicants' process is actually doing), especially considering the last two paragraphs of the body of applicants' disclosure present deposition of an oxide film of controlled roughness as an alternative to use of the fragmented film or formed droplets, instead of using them as catalyst for growth of nanotubes, thus applicant's implied arguments would appear to contradict their own specification!

With respect to **species A**, it is unclear to the examiner is why applicants consider use of a heat treatment, or use of hydrogen plasma treatment at low temperature, in order to form a discontinuous thin film into drops (or to cause fragmentation of the layer on the support) to be equivalent techniques, as one only specifies use of heat, while the other specifies particular chemical usage (hydrogen & ionization effects), essentially excluding heat (low temperature), thus why applicants apparently think the same mechanism is involved in these process species, such that they should be considered equivalent is not

apparent, nor have applicants provided any reason or evidence to contradict the examiner's previous statements concerning the differentiation of these mechanisms, as to why they should be considered to employ like mechanisms to produce the claimed effects (drop formation or fragmentation of the layer, which is not the same as forming drops).

If the examiner were to withdraw the species requirement based on applicants' traversal, it would be considered that the heat treatment to be equivalent to the hydrogen plasma treatment for purposes of rejection, such that any heat treatment would be considered equivalent to any hydrogen plasma treatment, or vice versa, for purposes of rejection. Similarly, it would be considered that any formation of carbon nanotubes or nanofibers would be equivalent to the formation of any oxide layer, however as applicants have not provided any support for such implied equivalents, nor a clear statement on the record (merely innuendo), the examiner is not convinced that either of these sets of species are not distinct species, hence neither species requirements will not be withdrawn.

The examiner notes that while claims 7 & 15 which deposit the generic material layer with a partial pressure of oxygen, have been grouped as generic, the only an enablement in the specification for this limitation is found in example 3, which is limited to hydrogen plasma post-treatment of nickel layer is 3 nm or 10 nm thick, thus the specification provides no evidence that it is effective in any way with respect to a post-treatment via heat treatment.

The requirement is still deemed proper and is therefore made **FINAL**.

2. **Claims 1-2, 4-10 & 13-18** are rejected under 35 U.S.C. **112, second** paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The preamble of **claim 1** is directed to a "process for manufacturing a fragmented layer of a material on a support", which describes an intended use that is never required to be produced in the body of the claim, such that the body of the claim is not commensurate in scope with the preamble, making the

scope of the claim & its dependent claims uncertain. The result in the actual steps in the claim are recited as "putting this thin layer into drops", where as was previously observed "drops" have a totally different meaning & scope than "a fragmented layer of material" (see previously provided definition in Webster's), thus do not represent forming a results desired by the preamble even by paraphrasing. The definition of "drop" which make the most sense in the context of applicants' process is "the quantity of fluid that falls in one spherical mass", although alternate definitions of "the smallest practical unit of a liquid measure" or "something that resembles a liquid drop", also makes sense in the context of the body the claim, i.e. heating, as in the elected claim 2, to liquefied deposited material & turn the layer into drops, which may drip off the substrate, however none of these meanings are consistent for the claimed phrasing as presently written with "a fragmented layer of material", which suggests spatially separated solids, suggesting that this is a poor translation or an incomplete description of applicants' intent (?would disclosure as found on p. 7, lines 5-8 be more appropriate, where the *context* is specified as the structure of the film?). Also see independent **claim 13** for an analogous problems, as well as **claims 10 & 18**, which while they depend from claims 1 or 13, respectively, only refer to the limitations of the preamble, such that it is unclear if the actual steps of the independent claims are required or desired to be preformed.

Use of **relative terms** that lack clear metes and bounds in the claims, or in a clear definition in the specification or in relevant cited prior art, is vague & indefinite. In **claims 1 & 13** particularly see "**thin**" in "thin layer", or what scope of thickness is encompassed by "thin layer" is not defined, thus uncertain, such that given deposition of any material, by any means to form a layer on any support, has no determinable thickness. It is noted that while the examples & p. 12, lines 9-10 provide examples of thin layers or thin films, *examples do not constitute definitions*, thus do not provide defined meanings to this relative term in the claims. In **claims 4 or 13**, "thermal or **diffusion** barrier layer" or analogous phrasing contain relative terminology in that what the diffusion barrier is protecting against is not defined (i.e. diffusion of what to where), thus uncertain. It is noted that there is no disclosure of "thermal barrier

layer" in the body of the specification, so what temperature environment is being protected against cannot be determined.

Use of "**this**" as an article is nonstandard patent terminology that cannot be considered to be clearly or necessarily for showing antecedent basis. Particularly see the last lines of **claims 1 & 13**, as well as **claims 10 & 18**.

**Claims 8 & 16**, while generally directed to "producing a catalytic metal layer according to claim 1" or "... claim 13", respectively, fail to provide a clear connection between how the catalytic metal layer relates to anything produced in either of the independent claims, such as it is unclear **as written** what relationship if any, the catalytic metal layer can be considered to have to the process of the independent claims. Furthermore, while the preamble of these dependent claims recite "a growth process of carbon nanotubes or nanofibers", the body of these claims steps only refer to "growing nanotubes or nanofibers", such that it becomes unclear whether or not they are actually intended or required to be made of carbon.

**Claims 10 & 18** are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. For these claims as written it is unclear how they further limit the independent claims, in that the fragmented layer required to be produced is already that of the preamble & no further structure is required, noting that any process it is causing fragmentation, may be considered controlled & any fragmented surface will necessarily or inherently be rough, thus have a controlled roughness. Furthermore, if drops were consistent with fragmented (such as description of probable intent as provided on p. 7 of the specification), then the form that structure on the surface would also inherently be controlled, thus provide no necessary new meaning, merely different semantics.

3. The examiner notes that any **specification**, on p. 3, lines 23-27 provides the definition "**Deposition in discontinuous form** means a sequence of deposits of the same material separated by

waiting phases under a vacuum or in a controlled atmosphere, in other words the deposition is discontinuous in time" (emphasis added). Note that this is NOT the same phrasing as is used in the claims, nor is the meaning art recognized as a necessary definition, hence this definition does not apply to the claims, which instead recite "a deposition step for depositing, it in a discontinuous **manner...**" (emphasis added), which encompasses the meaning defined in applicants' specification, as well as spatially discontinuous deposition, either all at one time using a mask or spread over time, or the like.

4. The **disclosure** is **objected** to because of the following informalities:

On **p. 10**, lines 13-14, the superscript should not be divided between two lines, as in this format it does not appropriately show an exponential number, which would appear to be what was actually intended.

On **p. 8**, the discussion in the written specification & the tables that follow, are not consistent, as "distribution parameters for particles..." implies how the particles are arranged, such as their separation, not discussion of parameter measurements of the particles, as implied by preceding discussion. Supported clarification would be appropriate. [Assuming "Ni thickness" is intended to be the thickness of a deposited nickel layer, "Average" the average diameter of nickel drops formed (whether on the TiN, or freestanding particles dropped off the TiN surface, not disclosed) & standard deviation of that diameter, the examiner notes example 1 provides no conditions under which the Ni "deposited continuously" was performed (e.g. deposition source & parameters therefore our surface on which deposition was performed, etc.), nor any parameters with respect to the discontinuously electron gun deposited nickel (i.e. whether the discontinuous deposition was spatially discontinuous &/or followed the p. 3 definition of "deposition in discontinuous form" & if so what kind of vacuum or controlled atmospheres were employed & particularly lengthens of "waiting phases", e.g. 1 femtosec, 1 psec, 1 ns, 1 ms, 1 sec, etc.). Although, the discussion with respect to figures 3(A & B) on p. 8, line 24-p. 9, line 5, while not stated to be images made of the preceding experimental & comparison deposits, that location of the discussion implies a

possible relationship, but even if these figures are from the preceding experimental & comparison examples (not necessitated by the specification), they cannot be visually compared as they are provided with different magnifications, preventing meaningful comparison.]

Appropriate correction is required.

The **specification** is **objected** to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: in claims 4 & 13 there are claims to the option of depositing a "thermal" barrier layer, however no discussion in the body of the specification discloses any deposition or use of a thermal barrier layer, in fact the only use of thermal therein is for discussion of "thermal CVD", thus the specification does not provide proper antecedent basis for this claimed subject matter.

The **abstract** of the disclosure is **objected** to because the abstract is not in proper form, in that it includes a fragment "figure 2." positioned as if it were a second paragraph. Also the title is not part of the abstract, as presently indicated on the separate abstract page. Correction is required. See MPEP § 608.01(b).

5. **Claims 1-2, 4-10 & 13-18** are rejected under 35 U.S.C. 112, **first** paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Applicant's broadest claims 1 & 13 deposit an unspecified material on the surface of an unspecified support, then unclearly treated to either form a fragmented layer or drops completely separate from the substrate support. This lack of clarity aside, assuming the intent is a fragmented layer that remains on the substrate support, as would be consistent with figures 2-4, the specification does not provide enablement for the scope of the claims, where any material may be deposited on any substrate, then formed into droplet structure or fragments on the substrate, in fact p. 4 of the specification indicates

that there is necessity that the deposited material not react with the support material, and the only examples of such materials found throughout the specification are the combination of a TiN layer, called a barrier layer, on which the deposited material that is to be formed into droplets on the surface is Ni. The examiner found no enablement or reason to expect from applicants disclosure for the claimed process to be functional for all support materials & all deposition materials as claimed. With respect to the elected species of heat treatment, the generic disclosure on p. 3, lines 18-21 lacks specifics for enablement, discussion on p. 4, lines 15-20 is directed to nonelected hydrogen plasma treatment; p. 6 is directed to deposition employing a device which may or may not be used in the examples (not specified therein); p. 7, lines 3 in 13 discuss "**A low temperature heat treatment or** hydrogen plasma treatment changes the deposited material into drops, in other words structures the film so as to form a discontinuous set of drops of material which is more or less homogeneous, and/or with more or less uniform shape, size and distribution... **Low temperature** typically means from **ambient temperature** (about 20°C) **to 500°C**, for example from 200°C to 500°C, and preferably about 300°C" (emphasis added), which would appear to exclude example 1 (pages 7-8) directed to 600°C "standard" heat treatment (unspecified hydrogen partial pressure) of a layer of Ni made "discontinuously" using an electron gun, where the support is a 60 nm thick TiN reactive cathartic sputter deposited layer. This is the only example found of applicants claimed elected process & does not provide enablement or expectation of effectiveness in the scope claimed.

However, the examiner notes if one takes the conventional meaning of drops, and ensures that the deposited and support material do not interact as recommended by the specification, plus employs commonsense in choosing a support material with a higher melting point than the deposited material, one could merely heat the layer composite until the material deposit melts, so as to drip off the support in form drops, which could be considered enabled, as it should be within the ability/capability of children to perform, and reads on such things as old-fashioned candle making & use thereof; or getting articles, such as absorbent clothing, wet, then in freezing weather, then hanging in a warm room to melt & drip dry.

**Claims 1-2, 4-10 & 13-18** are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for forming a droplet or beaded layer of Ni on TiN, via discontinuous (presumably temporal) vapor deposition of the Ni followed by heat treatment in a hydrogen containing atmosphere at 600°C, or more generally between 500°C-600°C, does **not reasonably provide enablement for deposition of any material on any support material, then heating to form drops or droplets or fragments, which may or may not remain on the support**. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. See above.

**Claims 7 & 15** are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for forming a droplet or beaded layer of Ni on TiN, via discontinuous (presumably temporal) vapor deposition of the Ni in an oxygen containing atmosphere, followed by plasma treatment in a hydrogen containing atmosphere at 300°C, does **not reasonably provide enablement for deposition of any material in an oxygen containing atmosphere on any support material, then heating to form drops or droplets or fragments, which may or may not remain on the support**. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. See above & further note that disclosure on p. 4, lines 21-24 is generic to the oxygen's affect on catalytic metal, but provides no enablement with respect to posttreatments, but is immediately following the disclosure of hydrogen plasma treatment at low temperatures of typically they hundred degrees centigrade; while the only exemplary discussion of the use of oxygen partial pressure during deposition is example 3, which only relates to employing Ni deposited on titanium nitride & hydrogen plasma treated at 300°C, thus providing no general enablement for partial pressure use of oxygen for deposition of all materials, or for deposition of metals generically, catalytic metals, or nickel specifically, when only heat-treated, as the examiner finds no evidence of any effect related solely to heating such a deposit.

**Claims 8-9 & 16-17** are rejected under 35 U.S.C. **112**, **first** paragraph, because the specification, while being enabling for employing a catalytic metal layer ((Ni) made by the enabled process of forming the catalytic metal layer as discussed above) to form carbon nanotubes or carbon nanofibers, does not reasonably provide enablement for forming nanotubes & nanofibers of unspecified materials using unspecified catalytic materials or unspecified catalytic metals. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. See above & p. 11, we're the only nanoparticles or nanofibers deposited our carbon resulting from the thermal CVD reaction of acetylene, thus no support or enablement was found for producing generic nanofibers & nanotubes as ambiguously claimed (see 112, 2nd above), as it is unclear how one would produce these structures using materials other than carbon & applicants' catalyst layer.

6. The following is a quotation of the appropriate paragraphs of **35 U.S.C. 102** that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of **35 U.S.C. 103(a)** which forms the basis for all obviousness rejections set forth in this Office action:

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names **joint inventors**. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The **nonstatutory double patenting rejection** is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

7. **Claim 1-2, 7 & 10** are rejected under 35 U.S.C. **102(b)** based upon a **public use** or sale of the invention, as being **anticipated** by the commonly known method of making candles by repeated dipping (discontinuous thin layer deposition process, performed in air having a partial pressure of oxygen) of a candlewick (support), then using the candle by lighting the wick (heat treatment), which forms drops of liquid wax that run down the surface & solidify creating a rough surface controlled by the degree of melting & dripping. Such candle making processes have been performed in colonial times & by children in elementary school (at least I did it about 40 years ago!), thus has long been known & in use.

While applicants may not have intended their process to encompass such an old and well-known process that has been **in use** for centuries, as presently written, the claims literally read on such processes.

8. **Claim 1-2, 7, 10, 13-15 & 18** are rejected under 35 U.S.C. **102(b)** as being anticipated by **Raaijmakers et al.** (2003/0234417 A1).

**Raaijmakers et al.** (abstract; figures, esp. 2-5; [0031-36, esp. 32-33]; [43-44]; [0048]; [0053-54]; [0062-63]; & [0071]) teach formation of a discontinuous layer on a conductive support, or a conductive support having an oxide interlayer (≡ thermo or diffusion barrier layer), where layer deposition may be via atomic layer deposition (ALD), with the initially deposited layer being a continuous layer, which is thereafter annealed in order to cause a restructuring of the thin layer, so as to form crystallize grains with gaps there between. This grain microstructure may be considered 'drop' shaped, & to read on applicants' "manufacturing a fragmented layer of material on the support" & "controlled roughness", noting that while the formation of the grain structure with gaps does not read on the literal meaning of "drops", it is consistent with meanings for "drops" suggested by applicants' specification, therefore may be considered to be encompassed by applicants' claim language's various possible meanings in light of the specification. Note with respect to the ALD deposition process, that it is a discontinuous process in the sense defined on p. 3 of applicants' specification, as it involves deposition cycles with pauses for purging between each deposition phase. Furthermore, as noted in example 1 in [0063], the deposition process includes an oxygen phase that employs water vapor to cause oxidation reactions of the deposited zirconium metal to form zirconia, thus during deposition there is inherently an oxygen partial pressure present during the oxidation reaction portion. With respect to thermal or diffusion barrier layers, it should be noted since no particular thermal or diffusion environment is indicated to be protected against by the claimed generic barrier layer, that the materials to provide the claimed effect are not limited, and virtually any intervening layer between the

support & the deposited material may be considered to read on the barrier layer requirement, such as Raaijmakers et al.'s oxide interlayer as illustrated in figure 5.

9. **Claims 1-2, 4, 6, 8-10, 13-14 & 16-18** are rejected under 35 U.S.C. **102(b)** as being anticipated by **Ida Lee** (WO 03/027011 A2) or **Merkulov et al.** (2002/0117951 A1).

**Ida Lee** (abstract; figures, esp.5-9; p. 8, lines 10-21 & 28-32; p. 9, line 5-p. 12, line 24, esp. p. 9, lines 8-10 & 18-22 & 29-p. 10, line 4+p. 11, lines 1-24+p. 12, lines 9-19) teaches metal (Ni) catalyst induced growth of carbon nanotubes, where the catalyst may be deposited on a buffer layer (e.g. titanium ≡ diffusion barrier layer) via an electrolytic deposition process that employs short (ns-ms) pulses of precisely controlled electric current in order to deposit 100-2500 atoms per pulse (i.e. a temporally discontinuous deposition process). Furthermore, example I discusses annealing Ni/titanium dots on a silicon substrate at elevated temperatures, where an initially continuous, disc shape nickel catalyst deposits balls up, & separates into multiple smaller dots or retains a single dot structure, dependent on various process parameters (dot size, thickness, buffer material, catalyst material, etc.). Carbon nanotubes structures are formed on the balled up nickel dots via a CVD process, such as one employing a mixture of acetylene & ammonia-helium. Note that the teaching of the annealing (heat treatment) causing balling up is consistent with meanings/context for "drops" suggested by discussion in applicants' specification, therefore may be considered to be encompassed by applicants' claim language's various possible meanings in light of the specification. Note that this process may also be considered to provide controlled shape, therefore controlled roughness.

Alternatively, **Merkulov et al.** (abstract; figures, esp. 1-2; [0023-31], esp. [0026-27 & 31]) teach growth of carbon nanotubes employing a catalytic precursor, such as Ni or other metals such as Fe or Co as catalyst, where catalyst nanoparticle(s) are formed, such as by employing an electron beam lithography process with electron gun evaporated metal on to a buffer layer, exemplified by Ti, which prevents diffusion of catalyst & catalyst silicide formation. The deposited layer may be a discontinuous deposition

via use of a resist layer to form a multiple dots or patterned arrays of dots. (Note this discontinuous deposition reads on the broader terminology employed in the claims, rather than the more specific definition applied to different language in the specification.) Before use as catalyst for forming the carbon nanotubes, the Ni/Ti may be plasma pre-etched in ammonia or hydrogen gas, & annealed at elevated temperatures (e.g. 700°C), where the titanium layer continues to adhere to the silicon substrate & where the initially continuous nickel layer thereon breaks into one or more little nanoparticle droplets (e.g. ≡ drops). Thereafter, carbon nanotubes are grown on the nanoparticle catalyst in a vertical direction via use of acetylene & ammonia gas mixtures.

10. **Claim 5** is rejected under 35 U.S.C. **103(a)** as being unpatentable over **Ida Lee (WO) or Merkulov et al.** (951), as applied to claims 1-2, 4, 6, 8-10, 13-14 & 16-18 above, and further in view of **Lee et al.** (EP 1061041 A1).

While **Ida Lee (WO)** teach buffer layers (e.g. diffusion barrier layer), such as Ti, W, Mo or W-Ti alloys, to prevent interaction (nickel silicide, etc.) between a substrate (Si) & the deposited catalyst (Ni, Co or Fe), or **Merkulov et al.** provides analogous teachings as discussed above, neither **Ida Lee (WO)** nor **Merkulov et al.** particularly specify TiN as their intervening/buffer/barrier layer, however **Lee et al.** (EP), who is also employing metal catalyst, such as Ni, Co, or Fe deposited via common thermal deposition, e-beam deposition or sputtering, then post-treated to be in nanoparticle form, as a catalyst for CVD deposition of carbon nanotubes; provides analogous teachings of employing intervening layers to prevent interaction between substrate and catalytic metal, where those intervening layers may be insulating film, such as silicon oxide or alumina, or metal films said to include Ti, titanium nitride, Cr or W. Thus Lee et al. (EP) is teaching the equivalence of Ti & TiN as barrier layers to prevent interaction between substrate & catalytic Ni in analogous processing steps, hence it would've been obvious to one of ordinary skill in the art to employ titanium nitride as an alternative buffer layer materials to the taught

metals of either primary reference, such as titanium, with a reasonable expectation of equivalent effectiveness due to their shown equivalence for like purposes.

11. **Teo et al.** ("Field emission from dense, sparse & pattern arrays of carbon nanofibers"): abstract; & 4th-5th paragraphs) provide equivalent teachings to those provided in **Lee et al.** (EP) in teachings options for diffusion barrier layers including TiN used with Ni catalyst, performing CVD carbon nanofiber structures.

12. **Claims 7 & 15** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Ida Lee** (WO) or **Merkulov et al.** (951), as applied to claims 1-2, 4, 6, 8-10, 13-14 & 16-18 above, and further in view of **Choi et al.** (6,538,367 B1).

Neither **Ida Lee** (WO) nor **Merkulov et al.** (951) provide teachings that would indicate the presence of any oxygen in during the deposition of their catalytic material. However, **Choi et al.** is also directed to techniques for depositing catalytic material that is to be employed for catalyzing carbon nanotube or nanoconductor formation, providing multiple alternatives for means of providing catalytic material (col. 5, lines 63-col. 7, line 41), mentioning that fine nanoparticles of iron, cobalt, nickel or their oxide particles are effective as catalyst for nanoconductor nucleation in growth; that deposition of metal catalyst (e.g. Fe, Co, Ni) thin films may be via CVD, electrochemical deposition or physical vapor deposition (PVD) techniques, with subsequent heating to cause particulate formation; that employing porous substrate material & short duration vacuum deposition techniques or electrochemical means to selectively fill catalyst particles into the porous substrate's surface; etc., are effective means for supplying catalyst; hence it would've been obvious to one of ordinary skill in the art that for Ida Lee's electrochemical deposition techniques or for Merkulov et al.'s electron evaporation technique (i.e. a PVD technique), that the presence of some partial pressure of oxygen would reasonably have been expected to provide no harmful effects, & would still have been expected to provide catalytic material even if oxide materials were formed, as the oxides of the taught metal particles of the primary reference's would also

have been expected to have catalytic properties for carbon nanotube construction. It is *further noted* that since a presence of a partial pressure of oxygen, includes **any partial pressure of oxygen**, no matter how minuscule, and as the claimed limitation with respect to oxygen partial pressure does not require any results from the presence of a partial pressure of oxygen, this claimed limitation may also be considered to include very low partial pressures that may result from evacuation of the atmosphere which are typically used in PVD techniques as taught by Choi et al. or Merkulov et al., which deposit metal & do not result in metal oxide deposits, thus further providing a reasonable expectation of the presence of at least some partial pressure of oxygen as claimed in any PVD process for catalytic metal deposition, since the vacuum is produced are not absolute vacuums, thus would have residual gas molecules inclusive of oxygen molecules.

13.           **Claims 1-2, 4-10 & 13-18** are provisionally rejected on the ground of **nonstatutory obviousness-type double patenting** as being unpatentable over claims 14-25 of copending Application No. **10/546,284**, optionally in view of **Ida Lee (WO)** or **Gao et al.** ("Plasma breaking of thin films into nano-sized catalyst for carbon nanotubes synthesis").

The copending application (284) claims are directed to overlapping scope claimed in different orders & employing during language, however both sets of claims are depositing material (may be Ni) on the support (may have titanium nitride barrier layer thereon), where the present application describes deposition of the material ≡ catalyst layer as being performed in a discontinuous manner, which encompasses the copending (284)'s claims of patterning the deposit via use of a mask during deposition. Also, both cases specified that the catalyst may be post-treated, with the instant case specifying "putting this thin layer into drops" via the electric process of heat treatment, while the copending case claims "annealing... to obtain a fractionation of the layer of the catalyst in the shape of drops", thus while employing different language, are presenting overlapping concepts, since annealing is a heat treatment, etc. While the copending case, when claiming carbon nanotubes growth as a catalytic drop structure,

does not particularly specify that the process is via vapor deposition, it would've been obvious to one of ordinary skill in the art to employ vapor deposition in the claimed carbon nanotube growth process, as the catalytic structure claimed for the nanotube growth would reasonably have been expected to be employed in a vapor process in order to provide selectivity as claimed, especially considering common techniques for such carbon nanotube growth are generally CVD techniques. Alternatively, if one considers applicants' taught meaning for "deposition in a discontinuous form", where the deposition is discontinuous in time rather than in space, with respect to be the claimed "discontinuous manner", the references of **Ida Lee** (discussed above), or **Gao et al.** (abstract & experimental procedure, using pulsed laser deposition of catalytic metal) provide teachings with respect to deposition of metal catalyst material intended to be fragmented into drops via post-deposition treatment processes, which are deposited via temporally discontinuous pulsed techniques; it would've been obvious to one of ordinary skill in the art, to employ such deposition techniques for the generic deposition of a catalytic layer of material of the copending claims, as these claims do not specify any particular means of deposition, thus one of ordinary skill would have been expected to employ techniques known to be effective in analogous art, such as Ida Lee or Gao et al. Furthermore, both of these references also when teaching their carbon nanotubes synthesis on the fragmented catalytic material, particular specify CVD growth conditions for producing the carbon nanotubes, thus supporting the above assertion with respect to the obviousness of employing CVD techniques with fragmented or particulate catalytic layers.

Note with respect to the presence of a partial pressure of oxygen during the deposition, which requires no specific partial pressure, nor any effective from the partial pressure of oxygen, that it may be considered that virtually any process as discussed above that is performed on earth, even if vacuum deposition conditions are employed, will have some partial pressure of oxygen, even if it is extremely small, as absolute vacuum is not employed, so some very small partial pressure of air would have been expected to be present & air has has itself a partial pressure of oxygen.

This is a provisional obviousness-type double patenting rejection.

14. **Claims 1-2, 4, 6-10 & 13-18** are rejected on the ground of **nonstatutory obviousness-type double patenting** as being unpatentable over claims 1-21 of U.S. Patent No. **7,544,547 B2** (Fournel et al.), in view of **Ida Lee (WO)** or **Gao et al.** ("Plasma... nano-sized catalyst...").

**Claim 5** is rejected on the ground of **nonstatutory obviousness-type double patenting** as being unpatentable over claims 1-21 of U.S. Patent No. **7,544,547 B2** (Fournel et al.), in view of **Ida Lee (WO)**, in view of **Lee et al. (EP)**.

The copending patent (547) to overlapping inventors is directed to a process having overlapping subject matter with the present claims, claimed employing varying nomenclature & varying orders, plus while having additional steps not presently required, these additional steps are also not excluded by the present set of claims. Particularly the copending claims only require generic deposition of a first material used for catalytic growth of nanostructured materials, where the nanostructures are organized periodically via fractional station by heat treatment, which is considered equivalent & overlapping with the presently claimed nomenclature. Also while the copending claims specify growth of nanostructures, they do not particularly specify that their nanostructures are carbon ones, however as noted above applicants' claims are ambiguous due to inconsistent nomenclature, as to whether or not they're nanotubes or nanofibers must necessarily be carbon. It is also noted that while the patent claims do not use the terminology "thermal or diffusion barrier layer", they do claim the use of an intermediate layer deposited on the support surface, with listing of such materials inclusive of SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, diamond, etc., which materials will effectively & inherently produce thermal &/or barrier properties depending on environmental exposure.

With respect to the claimed "discontinuous manner", the references of **Ida Lee** (discussed above), or **Gao et al.** (abstract & experimental procedure, using pulsed laser deposition of catalytic metal) provide teachings with respect to deposition of metal catalyst material intended to be fragmented into

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drops via post-deposition treatment processes, which are deposited via temporally discontinuous pulsed techniques, therefore it would've been obvious to one of ordinary skill in the art, to employ such deposition techniques for the generic deposition of a catalytic layer of material of the copending patent (547) claims, as these claims do not specify any particular means of deposition, thus one of ordinary skill would have been expected to employ techniques known to be effective in analogous art, such as Ida Lee or Gao et al. Furthermore, both of these references also teaching the use of their catalyst for particular nanostructures synthesis of carbon nanotubes synthesis on the fragmented material, particular specify CVD growth conditions for producing the carbon nanotubes, thus providing motivation for employing their taught CVD techniques with fragmented or particulate catalytic layers to produce such carbon nanotube structures.

With respect to the use of particular catalytic metal & deposited on particular underlying (diffusion barrier layer) material, as discussed above Lee et al. (EP), in combination with Ida Lee, provides for the obviousness of this specific combination of materials one particularly depositing carbon nanotubes, thus given taught equivalents (discussed above) of titanium nitride, with titanium, and the desirability of using such titanium or titanium nitride barrier layers would specifically depositing carbon nanotubes on the catalytic material, it would've been obvious to use these specific materials for their expected effectiveness in the process.

See above discussion concerning oxygen partial pressure (section 13), which is also relevant here.

15. **Claims 1-2, 4, 6-10 & 13-18 are provisionally rejected on the ground of **nonstatutory obviousness-type double patenting** as being unpatentable over claims 25-42 of copending Application No. 11/915,238, optionally in view of **Ida Lee (WO) or Gao et al.** ("Plasma breaking of thin films into nano-sized catalyst for carbon nanotubes synthesis").**

**Claim 5** is provisionally rejected on the ground of **nonstatutory obviousness-type double patenting** as being unpatentable over claims 25-42 of copending Application No. **11/915,238**, in view of **Lee et al.** (EP) optionally in view of **Ida Lee (WO)** or **Gao et al.** ("Plasma...").

The copending **application (238)** claims are directed to overlapping scope claimed in different orders & employing during language, however both sets of claims are depositing material that may be employed for catalytic CVD formation of nanostructures, where these materials are deposited on surfaces that may have diffusion barrier layers thereon & maybe heat treated to cause fragmentation, as the copending application's language of increasing the temperature is synonymous therewith. Copending (238) provides generic disclosure with respect to depositing means for their catalyst layer, however specifically relates to using resist structures for patterning to create a discontinuous deposit, thus is analogous to discussion of copending (284) in section 13 above, thus the teachings of **Ida Lee (WO)** or **Gao et al.** ("Plasma...") are optionally alternatively applicable to copending (238) for reasons as discussed above with respect to copending (284). The copending claims of (238) are silent with respect to specific barrier layer material or specific catalytic material, however the specific materials of nickel & titanium nitride used in the claimed catalytic processes would've been obvious given the teachings of **Lee et al.** (EP) for reasons as analogously discussed in section 14 above. Also note above relevant discussions with respect to carbon nanotubes versus nanostructures & partial pressure of oxygen.

16. **Claims 1-2, 6-8 & 10** are rejected under 35 U.S.C. **102(e)** as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over **Keller et al.** (2005/0000318 A1).

**Keller et al.** (abstract; [0029]; [0032-33]; [0039]; [0043-46]; [0049]; [0054-56]; [00 67 -72, esp. 71]; [0077]; & [0133]) teach a composition having a metal compound & organic compound, which went heat-treated decomposes to form metal nanoparticles, where the organic component may also decompose & react so as to form carbon nanotubes catalyzed by the presence of the previously formed metal nanoparticles. While the majority of the disclosure concerns bulk composition and synthesis, there are

also teachings with respect to forming films ([0070-71]; [0077] & [0133]), with it specifically taught that films may be formed of a plurality of layers or compositions, & that precursor compositions are cast as adjacent layers before formation of the metal nanoparticles in the composition, thus for such multi-composition cast coated constructions, the deposition may be considered to have been performed in a discontinuous manner. Furthermore, as the taught cast coating for forming films is a process that inherently requires casting onto a surface, a support is present; & as no specific atmospheric environment is taught to be employed during cast coating, this may be considered to imply the presence of air, thus the coating process may be considered to be done in the presence of a partial pressure of oxygen.

Alternatively, while no support is specifically mentioned as used during casting of layers for forming films, nor is it specifically mentioned that the process is done in the presence of air, it would've been obvious to one of ordinary skill in the art to perform the casting of layers to form a film in a conventional & typical manner, thus employ a support surface to enable shaping as a film, especially considering the technique of example 31 ([0133]) that forms a thin film of the composition on a silica surface, heat treats to form a Co nanoparticle-carbon nanotube results, further showing the obviousness of employing a support surface for taught cast coating of multiple layer &/or composition films. It would be no further obvious to one of ordinary skill in the art, that as the cast coating process is not sensitive to the atmospheric composition, to merely perform it in air, as the most efficient & cost-effective means of performing this step.

17.           **Claims 1-2 & 6-10** are rejected under 35 U.S.C. **102(e)** as being clearly anticipated by **Dominguez et al.** (2007/0196575 A1).

First, it is noted that this reference's filing date of February 21, 2006 is before applicants' filing date of 8/8/2006, however after applicants' French language priority documents (i.e. PCT filing date 2/7/2005 & French application 2/9/2004), hence may be removed by appropriate certified translations, but

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until priority is perfected back to a date preceding the reference's filing date it must be considered prior art.

In **Dominguez et al.**, see the abstract; figures; [0007-8]; [0011]; [0013-18, esp. 13 & 17-18]; [0020] & claims, esp. 1, 3-5 & 8-10, which teach deposition of a film containing active components that may be catalytic metals, such as nickel; & inactive components that may be Ti, Al, dielectric materials, e.g. oxides like titania. The film may be deposited by various techniques, such as sputtering, ALD (atomic layer deposition) or pulsed laser deposition (PLD), etc., where the specifically taught techniques of ALD or PLD, being pulsed techniques, are performed in a temporally discontinuous manner. After the film's deposition, it is heated to a temperature to cause phase separation of the materials to create catalytic sites described as nanoparticle catalytic centers, or agglomerate islands, or grains, etc., thus are considered to read on possible meanings of applicants' "putting... into drops". Thereafter, carbon nanotubes are formed on the catalytic sites via chemical vapor deposition. Furthermore, with respect to the depositions that are composites containing oxides, the PLD or ALD processes therefore would inherently encompass procedures having partial pressures of oxygen, since any reaction to form an oxide from a precursor requires the presence of oxygen, while any laser vapor deposition process of an oxide, even if it is not a reactive deposition process, would cause at least some dissociation of vaporized oxides, thus a partial pressure of oxygen.

18. **Other art of interest** includes: **Choi et al.** ("Density control of carbon nanotubes using NH<sub>3</sub> plasma treatment of Ni catalyst layer"), cited in the IDS, is of interest to the nonelected species of hydrogen-containing plasma pretreatment of a deposited material (Ni catalytic layer on Cr buffer layer), which issues that for catalytic growth of carbon nanotubes, & is equivalent to above applied references for the generic claims that do not specify require post-discontinuous deposition heat treatment, except it does not specify that the nickel is initially discontinuously deposited, either spatially or temporally; **Gao et al.** ("Plasma breaking of thin films into nano-size catalyst for carbon nanotubes synthesis"), also citing

the IDS, is similar to Choi et al., except deposits Fe thin films via pulsed laser deposition, then employs a N-plasma to break the thin film into uniform nano-size catalyst particles; **Ota** ("specific conditions for Ni catalyze carbon nanotubes growth by chemical vapor deposition") while teaching the post metal deposition heat treatment to control nickel particle sizes, deposits via CVD without teachings of any discontinuous manners; **Cotell et al.** ("Microstructural development of thin films grown by pulsed laser deposition"), cited in the IDS, shows that use of pulsed laser deposition versus other vapor deposition processes (i.e. a temporally discontinuous deposition process versus continuous) does not have any significant effect on the produced microstructure for a range of taught substrates & substrate temperatures, which indicates that applicants lack of operational/parameter details with respect to their temporally discontinuous deposition is a significant flaw in the disclosure.

Further art of interests includes: **Dai et al.** (WO 00/30141), who also teach patterned catalytic layers for vapor depositing carbon nanotubes, where the catalytic material may be a patterned film made using e-beam evaporation of iron through a shadowmask, with subsequent annealing in air to create patterned iron oxide catalyst; **Legagneux et al.** (WO 03/048040 A1), whose English abstract indicates relevant teachings concerning catalytic layers on a diffusion alloy barrier film, for use in catalytic growth of nanotubes/nanofibers; **Shin et al.** (2002/0014667 A1), who teach control of shape & size of catalyst pattern in order to control growth of carbon nanotubes, including discontinuous deposition the use of a mask, which may be removed after catalyst deposition by heating, however they are interested in depositing carbon nanotubes in a horizontal direction, thus deposited film does not provide any "drop" shapes after heating; **Kishi et al.** (2003/0098640 A1) provides teaching concerning metal thin film formation via vacuum evaporation or CVD, with subsequent heating to agglomerate catalytic sites, forming discontinuous film surface, where subsequent heating in oxygen atmosphere will catalyze reactions to process carbon nanotubes via oxidation (as opposed to form them); while **Hirasawa et al.** (2002/0171347 A1), **Simpson et al.** (2002/0024279 A1), **Geohegan et al.** (2006/0279191 A1), **Huotari**

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**et al.** (2009/0246367 A1 & 7491634 B2) & **Cheng et al.** (2002/0163287 A1), all provide further teachings concerning the use of catalytic metal layers used in the formation of carbon nanotubes.

Also noted of interest, are copending cases **12/412,497**, **12/004,883** & **11/174,537** to at least overlapping inventors that have claims directed to be relevant processes for catalytic formation of nanotubes or nanostructures, but presently do not necessitate an obviousness double patenting rejection.

19. **Any inquiry** concerning this communication or earlier communications from the examiner should be directed to **Marianne L. Padgett** whose telephone number is **(571) 272-1425**. The examiner can normally be reached on M-F from about 9:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free)?

/Marianne L. Padgett/  
Primary Examiner, Art Unit 1792

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